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ANALYSIS OF CT NUMBERS IN THORACIC CT SCAN IMAGE SEGMENTATION AND SPIROMETRY ON PULMONARY VITAL CAPACITY

Annila Suryo Saputro[1], Lenny Latifah[2], Siti Masrochah[3]
Poltekkes Kemenkes Semarang, Jawa Tengah, Indonesia

annilasuryosaputro@gmail.com[1], lenylatifah1@gmail.com[2], masrochah2@gmail.com[3]

ABSTRACT
This research aims to analyze the correct CT Number to calculate the capacity volume of vital lungs using process segmentation image CT Scans. Compare results from capacity volume vital lungs on segmentation with results measurement volume capacity vital from spirometry. The research method used is an applied experiment that compares the results of lung vital capacity volume in segmentation with the results of vital capacity volume measurements from spirometry. Testing is carried out by calculating each volume on the CT Number used in segmentation and then comparing it with results from spirometry. Analysis data use test Correlation Pearson And Test paired Q Test Results study show that application segmentation image CT Scans with CT Numbers -850 HU up to -950 HU is quite good in calculating the volume of vital lung capacity. There is no significant difference between the results of lung vital capacity volume in segmentation and the results of vital capacity volume measurements in spirometry with a value ($p > 0.05$) of 0.06. The conclusion of this research is that segmentation image CT Scans of Thorax with the use of CT Numbers -850 HU until -950 HU can considered as an alternative in calculating the volume of vital lung capacity in patients with COPD.

Keyword: CT Number, Spirometry, Segmentation.

Corresponding Author: Annila Suryo Saputro
E-mail: annilasuryosaputro@gmail.com

INTRODUCTION

The respiratory tract is a part of the human body that functions as a place to exchange oxygen and carbon dioxide during the respiratory process. In the respiratory system, there are lungs, which, in this case, play a very important role in the process of exchanging oxygen and carbon dioxide. In the era of globalization, air pollution has occurred significantly. Air pollution, such as motor vehicle fumes and industrial factory fumes combined with smoking habits, especially in industrial or urban areas, causes many complaints or diseases of the respiratory tract. As a first step in maintaining personal health, especially lung health, it is very important to know the volume capacity of vital lungs. Generally, a person's volume capacity for vital lungs is about 6 litres (Bakhtiar & WS, 2016). Naturally, the capacity for every person will differ depending on the disease, lifestyle, age, gender and activities carried out in daily life; for example, an athlete will, of course, have a larger vital lung capacity volume compared to a worker's office.

Lung function examination is a simple way to detect lung abnormalities or diseases. From the results of the inspection, we know. Whether the disorder is chronic obstructive pulmonary disease (COPD), lung disease can be treated immediately. Chronic obstructive pulmonary disease is a term that is often in use. For several diseases That attack the lungs and inner lungs, a period. COPD causes several deaths in the world. In 2021, 10.7% of the 36 million people will die from lung disease; in Indonesia, COPD sufferers will reach 9.2 million (Badan Penelitian dan Pengembangan Kesehatan, 2013). With the increasing prevalence of smoking in developing countries and the increasing population in the country, we can predict that the prevalence of COPD will increase in some time.

Spirometry is an examination that assesses the integrated mechanical function of the lungs and walls chest, And muscle Respiratory by measuring the amount of volume of air in exhale from forced vital capacity (KVP) to residual volume (Price et al., 2006) in the form of a ratio or litres/ml. Spirometry is the gold standard for diagnosing COPD and assessing its severity. Spirometry in measuring lung function in elderly patients often faces obstacles and misinterpretation in interpreting normal spirometry results as abnormalities. Road breath with the assumption exists COPD. Constraint other is there is on a patient with trauma tract respiratory or tumour on areas the so that inspection spirometry can not do with Good. Patient with an indication of Coronavirus 19 (COVID-19) before Carrying out a spirometry examination also requires an initial examination such as a PCR swab. Often, the treatment of patients like this experiences delays in diagnosis. For this reason, other supporting examinations are needed as an alternative to spirometry in diagnosing COPD.

Medical imaging technology at this time makes it possible to carry out imaging and post-processing of a medical imaging image to display organs or tissues of the human body. The development of medical imaging technology that can produce high-resolution spatial and contrast tissue images has made medical imaging technology a major diagnostic tool, especially in radiology (Bronzino & Peterson, 2018). One of the tools used in diagnosing This is a Computerized Tomography Scan (CT scan), Which can give some information diagnosis that is tall, accurate And appropriate. It is Good For measuring network soft body or volume. CT scan examination can help diagnose COPD and provide the location of the spread of emphysema, bronchitis, bullae, bronchiectasis or cyst/tumour. A chest CT scan can generally be used to evaluate the features of emphysema and chronic bronchitis, which are part of COPD. CT scan of the Thorax using the LDCT (Low Doses Computed Tomography) technique is believed to be able to reduce the radiation dose received by the patient (Sun et al., 2014); (Sun et al., 2017); (Ryan et al., 2021). With the development of CT Scans, a radiologist or radiographer can provide a method or protocol for CT Scan examinations to confirm disease diagnoses, including calculating lung volume. One way to calculate lung volume is to limit the area (segmentation) of the lung organ and the value of range Hounsfield (HU), Which is used to organ lungs. On condition emphysema, the Hounsfield unit value shown is less than -950 HU at the time of the inspiration (Moutafidis et al., 2021); (Camiciottoli et al., 2006); (Wu et al., 2021); (Mohamed Hoesein et al., 2012).

The segmentation process is isolating an image or radiographic image from other objects (Banik et al., 2009). In isolating a radiographic image, it is necessary to set a threshold value for the isolated object (Spillane et al., 1993); (Webb, 1989). The threshold value from an object can be used To count the density, type of tissue or volume of an object. The application of segmentation to CT scan radiographic images can be used to improve the diagnosis of the patient's disease, such as measuring volume bleeding intra cranial, volume lungs, wide And volume from A nodule, rock on ureter or in the urethra, racist in cancer, etc.

In its application, the segmentation process can be manual, fully automated, or semi-automatic. In manual segmentation, the process is carried out manually by drawing contours, cutting, and cropping, which can be done on a series of axial cuts or a multiplanar reconstruction view.

Meanwhile, automatic segmentation is a further development from software provider companies. The advantage of automatic segmentation is that it saves time in the segmentation process if the data is large enough. Because this automatic segmentation process still uses threshold values (Banik et al., 2009; Webb, 1989) as a reference in segmenting, intervention from application users is still very much needed. Concerns and lack of understanding related to dose radiation And effect besides making Wrong One reason The application of segmentation in calculating lung volume in Thoracic LDCT examinations is rarely applied to chronic obstructive pulmonary disease, so treatments for this disease are often encountered. Late.

In previous research, segmentation in Lung Cancer cases used MATLAB software to perform segmentation contouring of lung nodules. With the results of using this MATLAB model, it can be used to determine cancer nodules with a sensitivity level of 88.4% to 92%. In other research, segmentation can also be done to improve diagnoses in patients suffering from Covid 19 using deep learning.

Because of That, study process inspection spirometry And Thoracic CT Scan examination accompanied by segmentation with CT Number variations, namely -500 HU to -950 HU (Spillane et al., 1993), -750 HU to -950 HU (Wu et al., 2021), -850 HU to -950 HU (Sørensen et al., 2020) and -910 to -950 HU (Akira et al., 2009) which were then analyzed to obtain the best threshold range for determining vital capacity volume lungs.

Lung function examination is a simple way to detect lung abnormalities or diseases. From the results inspection, they can find out whether the disorder is chronic obstructive pulmonary disease or not so that treatment for the lung disease can be immediately resolved. Spirometry is the standard for measuring vital lung capacity volume but for chronic obstructive pulmonary disease patients (COPD) complicated by respiratory tract trauma or tumours in this area will experience problems not being able to undergo a spirometry examination.

Thoracic CT Scan examination has a high level of sensitivity in diagnosing the location of the spread of emphysema, bronchitis, bullae, bronchiectasis and cysts/tumours, including identifying the volume capacity of vital lungs. Process segmentation in count volume capacity Lung vitals on inspection CT Scans Thorax needs His determination range mark CT Numbers so that the results obtained can represent the volume of vital lung capacity. From that background in conveying the study's objective, there are different results of calculating the volume of vital lung capacity using CT Scan image segmentation with spirometry in patients with COPD. This research implies helping ensure that accurate CT Number measurements can be utilized in the process of CT Scan image segmentation, enabling more precise monitoring of the development of lung diseases over time. The implications of this study could also stimulate the development of technologies related to CT Scan image segmentation. Through this research, the medical community can gain a deeper understanding of the use of CT Scan image segmentation and CT Numbers in the context of lung vital capacity.

METHOD

This type of research is applied to experimental research by comparing the results of measuring the volume of vital lung capacity using the segmentation method with the results of measuring the vital capacity of the lungs using spirometry. The data used in this study is secondary data with retrospective data collection from January 2022 to December 2022. The population in this study were COPD sufferers who underwent CT scans and spirometry examinations at Persahabatan Hospital. The sample in this study was COPD patients who met the inclusion and exclusion criteria. Sampling was carried out sequentially, sampling Where patients who fulfilled the criteria were inserted into the research until the number of subjects in need was fulfilled. Sample study intake from COPD population, Which has upright diagnosis by doctor specialist pulmonology based on anamnesis And spirometry results accompanied inspection CT Scans Thorax in a record medical patient. Technique processing data, namely by editing and checking the data obtained in the form of accuracy of medical record numbers, date of birth, weight, height, questionnaires, data entry, and coding. The Statistical Program for Social Science program (SPSS) is the data analysis used.

RESULTS AND DISCUSSION

Characteristics of the CT Number Hounsfield unit data range.

Normality test

The data obtained in this research is then grouped, and a normality test is carried out to determine the data's normality level and the next statistical test that will be used.

Table 1. Normality Test

Data	N	Valid Per cent	Sig.ρ
Average Vital Capacity	50	100.0%	0.688
Volume 1 (-500 HU to -950 HU)	50	100.0%	0.264
Volume 2 (-750 HU to -950 HU)	50	100.0%	0.230
Volume 3 (-850 HU to -950 HU)	50	100.0%	0.775
Volume 4 (-910 HU to -950 HU)	50	100.0%	0,000

With data distribution

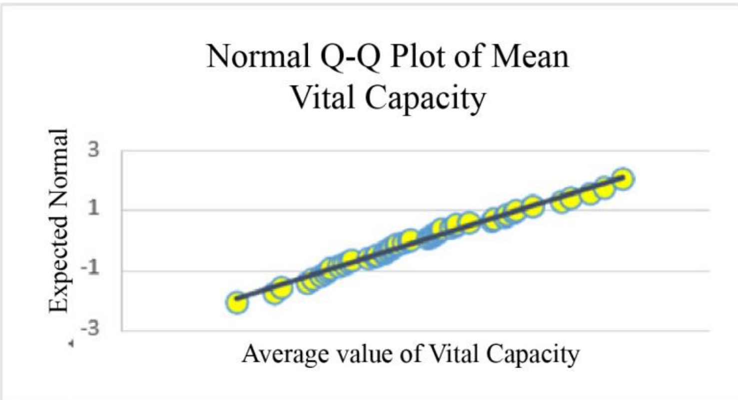

Figure 1. Normal QQ Plot of Average Vital Capacity

From the graph of the relationship between the normality of average lung vital capacity in spirometry measurements with opportunity normality, the mark from average capacity vital is near the line Z normality probability score and significance of ρ 0.688.

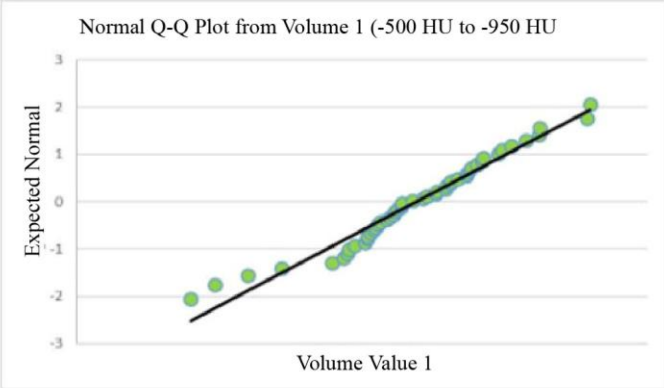

Figure 2. Normal QQ Plot volume 1 (-500 to -950 HU)

From the graph of the relationship between the normality of volume 1 (-500 to -950 HU) in the chest CT scan image segmentation measurements with the probability of normality, it can be seen that the value of volume 1 is close to the Z score line of the probability of normality and the significance is ρ 0.264.

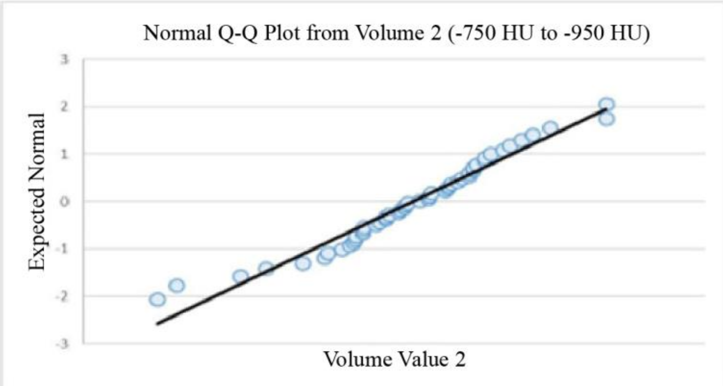

Figure 3. Normal QQ Plot volume 2 (-750 to -950 HU)

From the graph of the relationship between the normality of volume 2 (-750 to -950 HU) in the Thoracic CT Scan image segmentation measurements with the probability of normality, it can be seen that the value of volume 2 is close to the Z score line of the probability of normality and the significance is ρ 0.230.

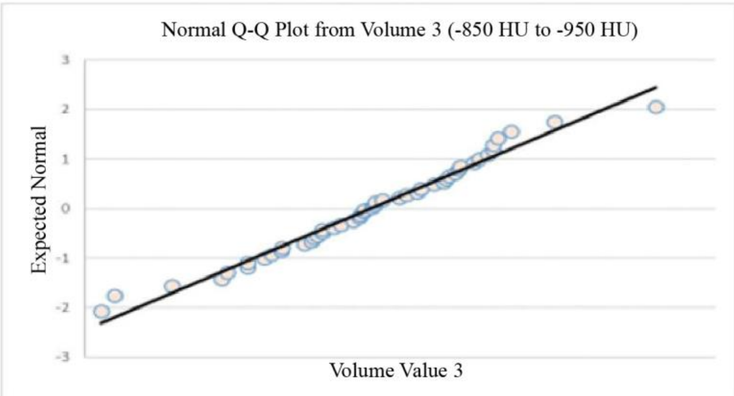

Figure 4. Normal QQ Plot volume 3 (-850 to -950 HU)

From the graph of the relationship between the normality of volume 3 (-850 to -950 HU) in the Thoracic CT Scan image segmentation measurements with the probability of normality, it can be seen that the value of volume 3 is close to the Z score line of the probability of normality and the significance is ρ 0.775.

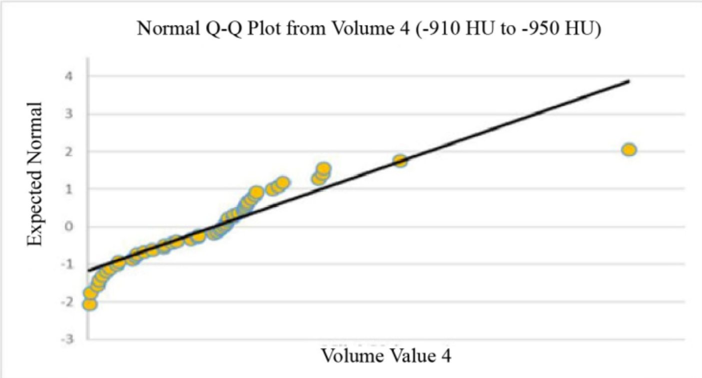

Figure 5. Normal QQ Plot volume 4 (-910 to -950 HU)

From the graph of the relationship between the normality of volume 4 (-910 to -950 HU) in the Thoracic CT Scan image segmentation measurements with the chance of normality, it can be seen that the value of volume 4 is heterogeneous. Most values of volume 4 are far from the Z score line of chance of normality, and the significance is ρ 0.000.
With average

Table 2. Mean KV, volume 1 to volume 4

	Average	Value Min	Value Max	Median
Vital Capacity (KV)	2,037	777	3,403	1,952
Volume 1 (-500 to -950 HU)	3,570	1,200	5,402	3,476
Volume 2 (-750 to -950 HU)	3,180	713	5,050	3,189
Volume 3 (-850 to -950 HU)	2,264	126	4,528	2,247
Volume 4 (-910 to -950 HU)	1,051	13	4,528	1,127

From the results of the normality test on lung volume research data in the application of spirometry with the application of the Thoracic CT Scan image segmentation method, it can be seen, with a significance level of ρ 0.688 For average capacity vital (KV), significance ρ 0.288 For volume 1 (-500 HU until with -950 HU), a significance of ρ 0.230 for volume 2 (-750 HU to -950 HU) and a significance of ρ 0.775 for volume 3 (-850 HU to -950 HU) can be interpreted as the average capacity vital, volume 1 (-500 HU until with -950 HU), volume 2 (-750 HU until with -950 HU) and volume 3 (-850 HU to -950 HU) have a normal distribution which a paired T-test will then follow to see whether there is a difference in lung volume measurements with use spirometry And usage segmentation image CT Scans thorax. Whereas for volume 4 (-910 HU to -950 HU), where the significance of ρ is 0.000 and can be seen in the distribution pattern of the values which are mostly away from the Z score of normality, the data can be interpreted as volume 4 (-910 HU until with -950 HU) No distribute normal so that For see the difference test on this data using the test Wilcoxon.

Differential test on research data

From the lung volume research data, a difference test was carried out between the spirometry results and the lung volume segmentation method results.

a. Test different volumes 1 (-500 HU to -950 HU), volume 2 (-750 HU to -950 HU), volume 3 (-850 HU until with -950 HU) And Volume 4 (-910 HU until with -950 HU).

Table 3. Range Difference Test HU

HU range	N	Lung Volume in segmentation	F	Sig.ρ
Volume 1 (-500 HU to -950 HU)	50	3570 ± 872	86,887	0,000
Volume 2 (-750 HU to -950 HU)	50	3179 ± 886		
Volume 3 (-850 HU to -950 HU)	50	2264 ± 863		
Volume 4 (-910 HU to -950 HU)	50	1050 ±770		

From different tests, volume 1 (-500 HU to -950 HU), volume 2 (-750 HU to -950 HU), volume 3 (-850 HU to -950 HU) and volume 4 (- 910 HU until with -950 HU), see that there is difference Which significant from results Test different volume 1 (-500 HU to -950 HU), volume 2 (-750 HU to -950 HU), volume 3 Volume 3 (-850 HU to -950 HU) and volume 4 (-910 HU to - 950 HU) with a significance of 0.000 each.

Post hoc tes

Table 4. Post hoc tes

Post Hoc Perbandingan Simultan Rentang HU Rentang HU	Sig.ρ
Volume 1 (-500 HU sd -950 HU) Volume 2 (-750 HU sd -950 HU)	0,102
Volume 1 (-500 HU sd -950 HU) Volume 3 (-850 HU sd -950 HU)	0,000
Volume 1 (-500 HU sd -950 HU) Volume 4 (-910 HU sd -950 HU)	0,000
Volume 2 (-750 HU sd -950 HU) Volume 3 (-850 HU sd -950 HU)	0,000
Volume 2 (-750 HU sd -950 HU) Volume 4 (-910 HU sd -950 HU)	0,000
Volume 3 (-850 HU sd -950 HU) Volume 4 (-910 HU sd -950 HU)	0,000

Post hoc mean plot diagram

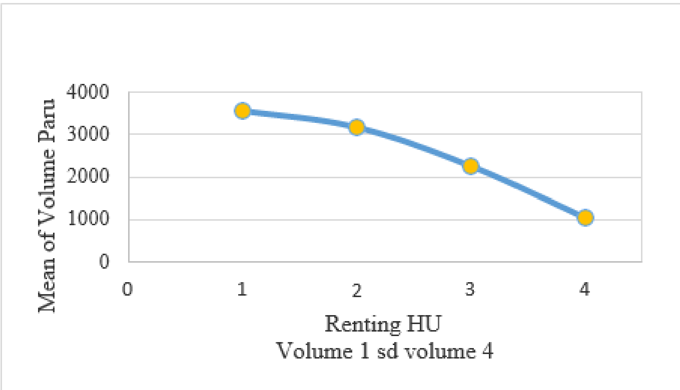

Figure 6. Post hoc mean plot diagram

In the post hoc comparison test for each average HU range from volume 1 to volume 4, it can be seen that in volume 1 (-500 HU to -950 HU) with volume 2 (-750 HU until with -950 HU) No, there is a difference Which significant For Lung volume results using the Thoracic CT Scan image segmentation method with a significance level of ρ 0.102. However, suppose you compare volume 1 (-500 HU to -950 HU) with volume 3 (-850 HU to -950 HU) and volume 4 (-910 HU to -950 HU). In that case, you can see a significant difference between each. The significance of ρ is 0.000. When comparing volume 2 (-750 HU to -950 HU) with volume 3 (-850 HU to -950 HU) and volume 4 (-910 HU to -950 HU), it can also be seen that there is a significant difference with each. The significance of ρ is 0.000. For a comparison of volume 3 (-850 HU to -950 HU) with volume 4 (-910 HU to -950 HU), it can also be seen that there is a significant difference with a significance ρ of 0.000 for each. Whereas on diagram mean plots post hoc comparison simultaneous range HU volume 1 (-500 HU until with -950 HU) until with volume 4 (-910 HU until with -950 HU), it seems to exist decline volume lungs results calculation segmentation image CT Scans Thorax from volume 1 (-500 HU to -950 HU) to volume 4 (-910 HU to -950 HU).

b. Test the mean difference between spirometry measurements and segmentation of Thoracic CT Scan Images with CT Number 1 (-500 HU to -950 HU)

Table 5. KV difference test with volume 1

Data	Number of Samples (N)	Test the Difference Sig.ρ (2 -tailed)
Average Vital Capacity - Volume 1 (-500 HU to -950 HU)	50	0.00

Based on Table 5, it can be seen that there are significant differences in the measurement results of the volume capacity of vital lungs on spirometry in comparison with the volume of vital capacity of lungs on segmentation image CT scans Thorax with level significance ρ value 0.00 smaller than 0.05.

c. Test the difference in mean Vital capacity with Volume 2 (-750 HU to -950 HU)

Table 6. KV difference test with volume 2

Data	Number of Samples (N)	Test the Difference Sig.ρ (2 -tailed)
Average Vital Capacity - Volume 2 (-750 HU to -950 HU)	50	0.00

Based on Table 6, it can be seen that there are significant differences in the measurement results of the volume capacity of vital lungs on spirometry in comparison with the volume of vital capacity of lungs on segmentation image CT scans Thorax with level significance ρ value 0.00 smaller than 0.05

d. Vital capacity mean difference test with Volume 3 (-850 HU to -950 HU)

Table 7. KV difference test with volume 3

Data	Number of Samples (N)	Test the Difference Sig.ρ (2 -tailed)
Average Vital Capacity - Volume 3 (-850 HU to -950 HU)	50	0.06

Based on Table 7, it can be seen that there is no significant difference in the measurement results of the volume capacity of vital lungs on spirometry in comparison with the volume Lung vital capacity in Thoracic CT scan image segmentation with a significance level ρ value 0.06.

e. Vital capacity mean difference test with Volume 4 (-910 HU to -950 HU)

In volume 4, which has an abnormal distribution, to test the difference, use the test, Wilcoxon.

Table 8. KV difference test with volume 4

Data	N	Asymp. Sig.ρ (2 -tailed)
Mean Vital Capacity - Volume 4 (-910 HU to -950 HU)	50	0,000

Based on Table 8, it can be seen that there are significant differences in the measurement results of the volume capacity of vital lungs on spirometry in comparison with the volume of vital capacity of lungs on segmentation image CT scans Thorax with level significance ρ value 0.00 smaller than 0.05.

Information results measurement volume capacity vital lungs on variation range CT Numbers towards patients COPD

From the research results measuring the volume of vital lung capacity on Thoracic CT Scan images using the Thoracic CT Scan image segmentation method with the CT Number range, it can be seen that there are significant differences between the four volumes, namely between volume 1 (-500 HU to - 950 HU), volume 2 (-750 HU to -950 HU), volume 3 (-850 HU to -950 HU) and volume 4 (-910 HU until with -950 HU) with level significance as big as 0,000. The research results show that the longer the range of unfilled units used in measuring lung vital capacity volume, the more the results of measuring the calculated lung vital capacity volume will be increase.

X-ray attenuation, which is represented in Hounsfield units in the digitalization era, represents the value of an individual pixel in a radiographic image, based on research by Katherine et al., that the value of an individual pixel of a CT Scan image (Katherine et al., 2021) can be represented by Hounsfield unit which can then be used for the segmentation process of a CT Scan image. From these data, researchers refer to the results of segmentation of Thoracic CT Scan images in measuring the volume of vital lung capacity from each volume 1 (-500 HU until with -950 HU), volume 2 (-750 HU until with -950 HU), volume 3 (-850 HU up to -950 HU) and volume 4 (-910 HU to -950 HU), namely the longer the counselled range units Which in use in something measurement image CT Scans so the more Lots pixels that will be counted (Romans, 2018).

Information on the results of measurements of lung vital capacity volume using spirometry in COPD patients

Spirometry in handling case COPD has made it standard in evaluating function integrated with mechanic lungs, wall chest And muscle Respiratory with measure number of volumes of air in exhale from capacity vital form ratio or litre/ml. In this retrospective study, the lung volume measurement was the vital capacity volume. This lung vital capacity volume can indicate the distension ability of the lungs and thoracic wall (Bakhtiar & Amran, 2019; Ginting et al., 2015). Measurement volume capacity vital lungs: Doing 3 exhalation breaths to obtain the average vital capacity lung volume. From the results of the average vital capacity volume, it can be seen that the patient has a good restrictive spirometry impression restrictive single nor mixture experience declined volume lungs, especially patients with moderate restrictive levels were compared to patients with obstructive spirometry effects and based on research from Arief Bakhtiar et al. along with similar research, it was explained that there was a relationship between capacity vital lungs with decline from volume lungs Which in case there are complications with disease others (Bakhtiar & Amran, 2019; Ginting et al., 2015). Decline lung volume shows no development organ lungs moment inspiration with matter. This can cause complications of disease clinical. This is even explained in a study by Chun-Chao Chuang et al., who explained that a decrease in lung elasticity and damage to the alveoli would reduce lung volume (Chuang et al., 2020).

The sample of COPD patients in this study from a chest CT scan showed that the cases of emphysema suffered by the sample were not isolated but were accompanied by cases of other diseases, such as emphysema with bronchitis or emphysema with TB. Emphysema case the most common in this study was centrilobular emphysema with bronchitis in as much as 40% or 20 patient samples, and this is also in line with the spirometry impression produced, namely as much 34 % or sample patients with impression spirometry mixture that is obstructive moderate to mildly restrictive. This shows that COPD is a lung disease characterized by an increased chronic inflammatory response in the airways, causing complications in the lung organs.

According to Cosson HO et al. Thoracic CT scans are more effective in diagnosing emphysema (Coxson et al., 2009; Hofmanninger et al., 2020), with a sensitivity level of around 96%. This is even in line with studies. This is where impression CT Scans For case COPD meet various cases of emphysema such as centrilobular, para septal and pan lobular emphysema. When examining thoracic CT scan images, the impression of a thoracic CT scan that is most frequently encountered is in cases of centrilobular emphysema. According to previous research, it is clear that complications of other diseases generally accompany the incidence of emphysema in COPD patients, and this is in line with the characteristics of emphysema in this study, which is mixed with complications of other diseases (Simargi et al., 2021). Centrilobular emphysema itself is the most common type of pulmonary emphysema. It is often encountered on CT scans of the chest in patients. COPD.

From the research results, it can be seen that there is a relationship between the volume of vital lung capacity and the volume of vital capacity of the lungs using the segmentation method with a positive relationship direction, Which means the big results measurement of volume capacity vital lungs on spirometry also goes hand in hand with the improvement in the results of lung vital capacity volume measurements using the segmentation method. However, the relationship between the volume of vital capacity of the lungs and the impression from spirometry has a negative or inverse direction, meaning the greater the results measurement of the volume capacity of vital lungs, the higher the level of complications in patients with COPD is getting lower. In other words, the results of measuring lung volume using the Thoracic CT Scan image segmentation method are related to clinical complications in patients with COPD.

Information on the accuracy of the spirometry segmentation method in calculating lung vital capacity

Studies previously explained that segmentation image CT scans Thorax is a selective process for transferring or isolating information from anatomical and pathological radiographic images (Katherine et al., 2021). The process of isolating a CT scan image of the Thorax is carried out by drawing the contour of the lung apex up to the costophrenic sinus on the axial CT scan image of the Thorax, which is then carried out by selecting the HU threshold of an organ. Anatomy.

From the research data using segmentation and statistical tests carried out, it can be seen from the results of different research tests that there is a significant difference with a significance of ρ 0.00 < 0.05 between the results of measuring the volume of lung vital capacity using spirometry and the segmentation method at a volume variation of 1 (-500 HU to -950 HU) and volume 2 (-750 HU to -950 HU) on the Thoracic CT Scan image. The difference in these measurement results can be seen from the length of the Hounsfield unit range used when segmenting the Thoracic CT Scan image to measure volume capacity. Vital lungs are very long, so areas of organ lungs Unaffected by COPD are entered into the calculation of lung vital capacity volume using the segmentation method. As for volume 4 (-910 HU until -950 HU) on image CT Scans Also show differences in Which Significant with ρ 0.00 < 0.05 between the results of lung volume measurements in spirometry and the method segmentation. This is Because the range of Hounsfield units in use moment segmenting the CT Scan image of the Thorax is very short, so it shows that the area of the lung organs affected by COPD is not fully accounted for in the method segmentation.

Moreover, for volume 3 (-850 HU to -950 HU) from the test results of this study, it appears that there is no difference in the results of measuring the volume of vital capacity of the lungs in spirometry with the results of measuring the volume of vital capacity of the lungs in the thoracic CT scan image segmentation method with a significance level of ρ 0, 06 > 0.05, this shows the range of Hounsfield units used when performing measurement volume capacity vital lungs Already count all over areas Which affected by COPD. In other words, the Thoracic CT Scan image segmentation method with a Hounsfield unit range of -850 HU to -950 HU can be used in certain conditions to calculate the volume of vital lung capacity in patients. COPD.

The limitation of this research is that the method used in this research is retrospective; it is hoped that prospective research can provide better results in measuring the volume of vital lung capacity in COPD patients, considering that the spirometry procedure used is maximum exhalation so that the maximum expiratory procedure is needed to be applied in Thoracic CT Scan examinations. This maximum expiration is also needed to calculate the vital capacity volume of COPD patients. The use of a more specialized spirometry tool is also needed to be able to calculate lung volume compared to conventional spirometry tools (Bakhtiar & Amran, 2019; Ginting et al., 2015).

CONCLUSION

There is a significant difference in the results of lung volume calculations between the four variations in the HU range, with an F value of 86.887 and a significance of ρ 0.00. The wider the HU range used, the more Lots mark pixels counted And influenced results from volume lungs. The average results of lung volume measurements using the DICOM CT Scan Thoracic image segmentation method with Hounds Field Unit (HU) – 500 to -950 is 3,570 ml, – 750 to -950 is 3,180 ml, – 850 to -950 is 2,264 ml and – 910 up to -950 is 1,051 ml. Results measurement on range CT Numbers – 500 until with -950 HU, – 750 to -950 HU and – 910 to -950 HU there is a significant difference with results on spi Prometric with significance ρ 0.00. Whereas on range -850 HU arrived with -950 HU No there is a difference Which significant in measuring volume vital capacity lungs on patient COPD with significance ρ as big as 0.06. Segmentation with CT Numbers -850 HU to -950 HU is an alternative to measuring vital lung capacity, especially in patients who cannot perform spirometry.

REFERENCES

Akira, M., Toyokawa, K., Inoue, Y., & Arai, T. (2009). Quantitative CT in chronic obstructive pulmonary disease: Inspiratory and expiratory assessment. *American Journal of Roentgenology*. https://doi.org/10.2214/AJR.07.3953

Badan Penelitian dan Pengembangan Kesehatan. (2013). Laporan Hasil Riset Kesehatan Dasar (Riskesdas) 2013. In *Kementrian Kesehatan RI*.

Bakhtiar, A., & Amran, W. S. (2019). Faal Paru Statis. *Jurnal Respirasi*. https://doi.org/10.20473/jr.v2-i.3.2016.91-98

Bakhtiar, A., & WS, A. (2016). Faal paru statis. *Jurnal Respirasi*, *2*(3), 91.

Banik, S., Rangayyan, R. M., & Boag, G. S. (2009). Landmarking and Segmentation of 3D CT Images. *Synthesis Lectures on Biomedical Engineering*. https://doi.org/10.2200/S00185ED1V01Y200903BME030

Bronzino, J. D., & Peterson, D. R. (2018). The Biomedical Engineering Handbook. In *The Biomedical Engineering Handbook*. https://doi.org/10.1201/b18423

Camiciottoli, G., Bartolucci, M., Maluccio, N. M., Moroni, C., Mascalchi, M., Giuntini, C., & Pistolesi, M. (2006). Spirometrically gated high-resolution CT findings in COPD: Lung attenuation vs lung function and dyspnea severity. *Chest*. https://doi.org/10.1378/chest.129.3.558

Chuang, C. C., Chou, Y. H., Peng, S. L., Tai, J. E., Lee, S. C., Tyan, Y. S., & Shih, C. T. (2020). Calculating air volume fractions from computed tomography images for chronic obstructive pulmonary disease diagnosis. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0231730

Coxson, H. O., Mayo, J., Lam, S., Santyr, G., Parraga, G., & Sin, D. D. (2009). New and current clinical imaging techniques to study chronic obstructive pulmonary disease. In *American Journal of Respiratory and Critical Care Medicine*. https://doi.org/10.1164/rccm.200901-0159PP

Ginting, M., Yunus, F., & Antariksa, B. (2015). Faal Paru pada Polisi Lalu Lintas Jakarta Pusat dan Faktor-Faktor yang Mempengaruhi. *J Respir Indo*.

Hofmanninger, J., Prayer, F., Pan, J., Röhrich, S., Prosch, H., & Langs, G. (2020). Automatic lung segmentation in routine imaging is primarily a data diversity problem, not a methodology problem. *European Radiology Experimental*, *4*(1). https://doi.org/10.1186/s41747-020-00173-2

Katherine, Rulaningtyas, R., & Ain, K. (2021). CT scan image segmentation based on hounsfield unit values using Otsu thresholding method. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1816/1/012080

Mohamed Hoesein, F. A. A., Van Rikxoort, E., Van Ginneken, B., De Jong, P. A., Prokops, M., Lammers, J. W. J., & Zanen, P. (2012). Computed tomography-quantified emphysema distribution is associated with lung function decline. *European Respiratory Journal*. https://doi.org/10.1183/09031936.00186311

Moutafidis, D., Gavra, M., Golfinopoulos, S., Kattamis, A., Chrousos, G., Kanaka-Gantenbein, C., & Kaditis, A. G. (2021). Low-and high-attenuation lung volume in quantitative chest CT in children without lung disease. *Children*. https://doi.org/10.3390/children8121172

Price, D. B., Tinkelman, D. G., Nordyke, R. J., Isonaka, S., & Halbert, R. J. (2006). Scoring system and clinical application of COPD diagnostic questionnaires. *Chest*. https://doi.org/10.1378/chest.129.6.1531

Romans, L. E. (2018). Computer tomography for technologist. In *2010*.

Ryan, D. J., Kavanagh, R. G., Joyce, S., O'Callaghan Maher, M., Moore, N., McMahon, A., Hussey, D., O'Sullivan, M. G. J., Wyse, G., Fanning, N., O'Connor, O. J., & Maher, M. M. (2021). Development and implementation of an ultralow-dose CT protocol for the assessment of cerebrospinal shunts in adult hydrocephalus. *European Radiology Experimental*. https://doi.org/10.1186/s41747-021-00222-4

Simargi, Y., Seprianto, J., & Santi, B. T. (2021). HUBUNGAN LAMA PAJANAN POLUSI UDARA DENGAN KEJADIANEMFISEMA BERDASARKAN PEMERIKSAAN CT SCAN TORAKSPADA SOPIR ANGKUTAN KOTA. *Jurnal Respirologi Indonesia*, *41*(2).

Sørensen, L., Nielsen, M., Petersen, J., Pedersen, J. H., Dirksen, A., & De Bruijne, M. (2020). Chronic obstructive pulmonary disease quantification using CT texture analysis and densitometry: Results from the Danish Lung Cancer Screening Trial. *American Journal of Roentgenology*. https://doi.org/10.2214/AJR.19.22300

Spillane, R. M., Shepard, J. A. O., & Deluca, S. A. (1993). High-resolution CT of the lungs. In *American Family Physician*. https://doi.org/10.1148/radiology.184.2.450-a

Sun, J., Peng, Y., Duan, X., Yu, T., Zhang, Q., Liu, Y., & Hu, D. (2014). Image quality in children with low-radiation chest CT using adaptive statistical iterative reconstruction and model-based iterative reconstruction. *PLoS ONE*. https://doi.org/10.1371/journal.pone.0096045

Sun, J., Yu, T., Liu, J., Duan, X., Hu, D., liu, Y., & Peng, Y. (2017). Image quality improvement using model-based iterative reconstruction in low dose chest CT for children with necrotizing pneumonia. *BMC Medical Imaging*. https://doi.org/10.1186/s12880-017-0177-9

Webb, W. R. (1989). High-resolution CT of the lung parenchyma. In *Radiologic Clinics of North America*. https://doi.org/10.1016/s0033-8389(22)01199-x

Wu, F., Chen, L., Huang, J., Fan, W., Yang, J., Zhang, X., Jin, Y., Yang, F., & Zheng, C. (2021). Total lung and lobar quantitative assessment based on paired inspiratory–Expiratory chest CT in healthy adults: Correlation with pulmonary ventilatory function. *Diagnostics*. https://doi.org/10.3390/diagnostics11101791